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DRAWINGS ATTACHED.

1,171,868

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COMPLETE SPECIFICATION.

Cutting Tool Holder.

I, KARL HERTEL, a German Citizen, of Oedenberger Str. 29, Nurnberg, Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a cutting tool holder having a cutting (e.g. carbide) tip comprising a cutting body made from a hard cutting material and a cutting tip shank which is fast with the cutting body rearwardly thereof.

It is known to form such cutting tool holders with a dove-tail-shape recess and to secure the tip inserted therein, by laterally engaging pressure and by means of a clamping jaw. When, in these known cutting tool holders, the lateral clamping jaws are arranged to engage a cutting body made of hard metal, a soft metal plate or lamella is interposed so as to ensure adequate securing of the tip relatively to the three cutting pressure components acting on it during machining.

It is known furthermore, in cutting tool holders of the type mentioned at the outset, to arrange the tip to be displaceable in a groove formed in the tool shank and to secure it, for the operational position, in the direction of the main cutting pressure and of the back-pressure, by means of a clamping claw or strap and a back-pressure screw engaging on its rear side. This design has, however, the disadvantage that it consists of an unnecessary multiplicity of parts which are easily lost, make manipulation of the tool difficult and the manufacture thereof expensive, and necessitate the provision of spare parts.

The invention is based on the problem of how to provide a cutting tool holder of the type mentioned at the outset which is simple and robust in design without being expensive to manufacture.

According to the invention there is provided a cutting tool including a holder and a cutting tip which is adjustable in a recess in a tool holder shank and which has a cutting body portion and a tip shank portion rearwardly thereof, the cutting body being made from a hard cutting material and secured fast with or formed integrally with the tip shank, and the tip shank being provided with a slot therethrough extending, and a headed securing screw anchored in the recess in the tool holder shank extending through the tip shank slot to secure the tip in the recess, adjustability of the position of the cutting tip in the recess being permitted in the direction of extent of the slot. The length of the tip shank slot is preferably at least as great as the depth of the cutting body in the direction of extent of the slot.

With this arrangement the tip can be adequately supported against the cutting pressure components acting on it by a construction of surprising simplicity. The tip is supported relatively to the main component of cutting pressure by the bottom of the recess in the clamping holder shank, the tip being firmly pressed against the bottom of the said recess by the securing screw.

The tip is supported relatively to back-pressure by its lateral walls, opposing the back-pressure of the recess (in the case of a curved roughing tool or side tool) and due to the clamping effect exerted by the securing screw, such clamping effect being effective throughout an extremely wide bearing range. The same applies to the taking up of the feed pressure acting on the cutting body during use of the tool.

The manipulation of the cutting tool holder during re-grinding of the cutting

[*Price* 4*s*. 6*d*.]

body is exactly like that involved in handling a commercially-conventional "soldered tool" where the cutting body is soldered to the tool holder shank. However, the present clamping tool holder has the advantage that when grinding the cutting body material is not also removed from the tool holder. Before grinding, the tip is advanced by a distance corresponding to the depth or amount of material to be removed during grinding. The mechanical securing of the tip is extremely simple and is also readily manipulated in the machine tool. The securing of the tip itself is "short" and free from oscillation, since it is effected in the immediate (i.e. optimum) vicinity of the cutting edge — similar to what is done with the known "soldered tool". Maintenance is not necessary at all. Furthermore, any lathe operator will be able to work with the cutting tool without special instruction; for this purpose, he only needs a spanner. When re-grinding the tip, the holder shank is not ground off at the same time, as is the case with conventional "soldered" turning tools having cutting bodies soldered directly onto the tool holder shank.

A special advantage of the cutting tool holder as compared with known "soldered tools" consists in that no diffusion effects arise, due to the soldering, from the base of the tip, so as, possibly, to detract from the cutting properties of the cutting body. The invention may be carried into effect with various sizes and shapes of tips. In the case of especially large cross-sections of the tip shank, it is possible to provide a multiplicity of securing screws one behind the other or, alternatively side-by-side, in various slots.

According to one embodiment of the invention, the shank of the securing screw is to engage, as a clearance fit, through the groove in the tip shank. At the same time, the shank of the securing screw is cylindrical.

According to a further embodiment, the shank of the securing screw is conically tapered in the direction towards the free screw end. This means that the tip shank may, when the securing screw is screwed in, be laterally spread, the result of this being secure anchoring within a recess, limited on both sides, on the shank of the clamping holder. For this purpose, the slot within the tip shank may be wedge-shaped, corresponding to the shank conicity, in the direction towards the slot bottom. Expediently, with an embodiment of this kind, the slot is open in the direction towards the rearward end of the tip shank, so as to permit lateral springing apart of the bifurcations of the shank of the cutting body. The slot in the tool shank may also be dovetail-shaped. In that case, the tip shank would require to be correspondingly designed. This design would ensure especially sure clamping.

A further embodiment of the invention consists in that the bearing face on the cutting tool holder has, at least over a portion of its longitudinal line of extending, a high degree of surface roughness. The said high degree of surface roughness of the bearing face may be achieved for example by the spraying-on of metal, by roughening, or, alternatively, by applying on the bearing face a layer of a material the surface of which has been appropriately roughened. It is entirely within the framework of this idea to provide, in place of a high degree of surface roughness of the bearing face, a covering layer on the bearing face, consisting of a material having a high coefficient of friction. What is in particular envisaged is the formation of the bearing face, at least over a portion of its longitudinal extending line, with notches which, when the securing screw is tightened, are pressed into the shank of the cutting or carbide tip and in this manner cause the mutual engagement of the bearing face of the holder and the tip. The notches are, in especially expedient manner, component parts of a file or rasp-cut fluting, the flanks of the notches which take up the back-pressure being more steeply inclined to the bearing face than the flanks remote from the back-pressure. With this arrangement, the tip may, in operation, be subjected to still greater stressing.

According to a modified embodiment, for the production of mutual toothed engagement between the bearing face and the shank of the tip, it is also possible to employ spikes which are let into at least a portion of the bearing face and the points of which project out of the bearing face.

The uneven portions of the bearing face may preferably be located in the zone thereof remote from the cutting body cutting edge, rearwardly of the axis of the receiving bore for the securing screw. Relatively thereto, the forward portion of the bearing face is here designed to be plane, the uneven portions (for example fluting or spike points) projecting above that plane which is formed by the forward, smooth receiving face portion. Consequently, the head of the securing screw, when it is screwed in, unilaterally presses the shank of the tip on to the uneven portions projecting out of the bearing face, the tip carrying out a small pivoting movement about the foremost point of the bearing face. In consequence of the fact that the uneven portions do not extend beyond the zone of the head of the securing screw which is acted upon in the direction towards the end of the recess remote from

the cutting edge when the securing screw is tightened, any bending moment which might otherwise act on the rear free end of the tip is avoided.

The bearing face may be constituted by the surface of a washer plate which is removably secured on the clamping tool holder shank. The washer plate is secured in lateral abutment against a recess in the cutting tool holder shank receiving the tip. With this arrangement, it suffices to provide a securing screw for securing the washerplate against rotation relatively to the shank of the cutting tool holder. If, then, the recess for recciving the tip is not limited by lateral abutment faces, then the washer plate is secured to the cutting tool holder by means of two securing screws one of which projects with its head into the slot in the tip in such manner that it bears flush against the lateral edges of the slot. The supplementary securing screw projecting with its head into the slot in the tip serves not only for securing the washer plate against rotation but also for preventing the lateral displacement of the tip.

A chip-breaker plate may be interposed between the head of the securing screw and the tip, the rearward shank of the chip breaker being formed with a slot corresponding to the tip shank slot. The securing screw engages through the said slot. Furthermore, the head of the above-mentioned supplementary securing screw for the washer plate also projects into the said slot.

The chip-breaker is, as to its height, preferably designed to taper in slightly wedge-shaped manner in the direction towards its rear end. The axis of the receiving bore for the securing screw extends perpendicularly to the surface of the chip-breaker, so that the slightly wedge-shaped design of the chip-breaker surface constitutes, in combination with the clamping force acting on the latter, a certain counter-pressure component acting against the back-pressure acting on the chip breaker.

Preferably a washer is arranged between the securing screw and the tip or chip-breaker, such washer being rotatable about in the screw axis but being non-releasably connected therewith. The said washer has the effect that, even in the event of extremely considerable tightening of the securing screw no torque is exerted on the chip-breaker or the tip and, furthermore, no spreading of the slot in the chip-breaker or the slot in the tip takes place.

The invention will now be further described, merely by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is an exploded view of a cutting tool holder embodying the invention and provided with a chip-breaker;

Figure 2 is a cross-sectional view taken through the head of a modified embodiment of the cutting tool holder;

Figure 2*a* is a view similar to Figure 2 but showing a further embodiment of the invention;

Figure 3 is an exploded view of the individual parts of a modified embodiment of the cutting tool holder suitable for use as a holder for a recessing tool;

Figure 4 is a part longitudinal sectional view of the recessing tool holder of Figure 3, in its assembled condition;

Figure 5 is an enlarged lateral elevation, partly in section, of a washer plate for the cutting body of the tool holder of Figure 3;

Figure 6 is a partial sectional view of modified embodiments of the washer plate of Figure 5;

Figure 7 is a lateral view of a securing screw provided with a rotatable washer secured against axial displacement therealong; and

Figure 8 is a perspective view of a particular embodiment of chip-breaker;

Referring to the drawings, the cutting tool holder shown in Figure 1 consists substantially of a tool shank 1, a cutting (or carbide) tip 2, a chip-breaker 3 and a securing screw 4. The tip 2 consists of a cutting body 5 and a tip shank 6 secured to the rear of the body 5. The tip shank 6 is made from tool steel and is connected in known manner, by hard soldering, with the cutting body 5. The cutting body 5 consists of a hard cutting material, for example carbide or hard metal. The tip 2 may also be manufactured in one piece from tool steel. It is formed with a slot 7 which extends in a direction to permit adjustment of the position of the tip relative to the tool shank, and which communicates through the shank from the shank cover face 8 as far as the shank base face 8^1. The tip shank slot 7 is at least as long as the useful working depth of the cutting body 5. The screw thread 9 of a securing screw 4 engages in a tapped bore 10 formed in the shank of the clamping holder. The tapped bore 10 is located in a recess 11 formed in the clamping holder shank 1 and is provided with a counter sunk portion. The shank 12 of the securing screw 4 is cylindrical and engages, as a clearance fit, through the cutting body slot 7. The head of the securing screw 4 is provided with a washer 13 which is in one piece with it. In the case of the embodiment according to Figure 2, the shank 12^1 of the securing screw is conical instead of being cylindrical.

Where the securing screw 4 has a conical shank 12^1, the maximum diameter of the shank 12^1 is larger than the maximum width of the shank slot 7. The head of the securing screw 4 or the

washer 13 is formed, in the surface facing the screw shank 12 or 12^1, with an annular recess 20. The annular recess 20 is adjacent the screw shank 12 or 12^1. It is the purpose thereof to take up material of the tip shank 6 which has been upset due to the tightening of the securing screw 4, without the "heaping-up" or accumulation of the said material having a detrimental influence on the securing behaviour of the screw 4. This is in particular necessary when the securing screw 4 having a conical shank 12^1 is used for securing a tip 2 having a slot 7 provided with walls extending parallel to each other (Figure 2*a*).

The shank slot 7 in the shank 6 has a closed periphery 14 although this is not essential as the slot may open rearwardly of the shank 6. Thus in an alternative embodiment the shank slot 7 extends as far as the rear end of the shank. Such shank slots 7 are especially suitable for use with securing screws 4 having a conical shank 12^1, wherein, in the tightened condition of the securing screw 4, bracing of the tip shank 6 relatively to the lateral wall 16 of the recess 11 takes place. In this case, the lateral walls of the slot 7 are expediently also designed, to correspond to the conicity of the screw shank 12^1, in such manner that they taper conically towards the base surface of the shank (Figure 2). This form of bracing may, however, also be involved with a tip shank having a slot 7 with a closed periphery 14, provided only that the fit between the width of the plate shank 6 and the receiving recess 11 is appropriately selected. It may be applied also in the case of tips having a parallel-walled slot 7.

In the case of the embodiment of Figures 1 and 2, the recess 11 in the clamping holder shank 1 is delimited by lateral walls 16 on both sides of the tip shank 6.

The body of the chip-breaker 3 has the peripheral shape of the end of the tip shank 6. The securing thereof above the tip 2 is effected by means of the same screw 4 as provides for the retaining of the tip 2. Due to the special shape of the chip-breaker 3, it is possible, once there is no useful life left for the cutting body 5, to convert a cutting tip 2 to a chip-breaker merely by correspondingly grinding the forward end face thereof, so as to change its shape.

In the case of the embodiment according to Figure 3, there is arranged at the forward end of the clamping holder shank 21 a recess 22 serving for receiving a washer plate 23, a tip 24 and a chip-breaker 25. The washer plate 23 is formed, in the zone thereof facing the cutting edge 24^1 of tip 24, with dirt grooves 26 extending in particular parallel to the forward edge 27 of the washer plate 23. The washer plate 23 has extending through it, furthermore, two passage bores 28, 29 through which project the securing screws 30, 31 projecting into securing bores 32, 33 in the cutting tool holder shank 21. The securing screws 30, 31 serve for retaining the washer plate 23 on the cutting tool holder shank 21, since, in this embodiment, no laterally delimited receiving groove for the washer plate 23 is provided. The head of the securing screw 30 is cylindrical and is several times higher than the head of a conventional securing screw.

The washer plate 23 is formed, furthermore, with a passage bore 34 for the main securing screw 35, serving for retaining the tip 24 and the chip-breaker 25 when anchored within a bore 36 in the cutting tool holder shank 21.

Commencing approximately level with the axis 37 of the passage bore 34 of the main securing screw 35 (Figure 5), the surface 38 of the washer plate 23 is formed with fluting or grooving 39 over an area extending rearwardly in a direction towards the end remote from the forward edge 27. The grooving or fluting 39, is so designed that the apices 40 thereof project upwardly, by an amount 41^1, beyond the plane formed by the forward surface 38. The flanks 41 of the grooving taking up the back-pressure, enclose, with the line of the bearing face 38, an angle which is larger than that which is enclosed by the bearing face 38 and the flanks 42 remote from the back-pressure. That is the flanks 41 are more steeply inclined to the bearing face 38 than are the flanks 42. The fluting face 39 does not extend over the entire rearward end of the washer plate 23, but extends only by an amount 43 corresponding to substantially half the diameter of the washer 44 for the securing screw 35.

The washer plates 23^1 according to Figure 6 are designed in substantially exactly the same manner as the washer plate 23. However, in place of the grooved face 39, they are each provided with a completely smooth surface 38^1 into which there are let in spikes 45 or 46 the points 47, 48 of which project out of the surface 38^1 by the distance 49 or 50. The spikes 45 are formed with only one point 47, whereas the spikes 46 are provided with central recesses or craters 51 at their projecting surface, the crater or recess rim being again notched. Consequently, a spike 46 has a plurality of apices 48, whereas the spike 45 has only a single apex. The spikes 45 or 46 are conical, their periphery tapering from below in the direction towards the bearing face 38^1. The receiving bores 52 for the spikes 45 and 46 are also designed to be appropriately conical. The spikes 45, 46 are soldered or jammed into the bores 52 or are merely inserted therein.

In this way, they may be replaced by new spikes, when damaged.

The tip 24 consists of a forward cutting body 53 and a rearward shank 64. The cutting body 53 may be made in particular from hard metal, whereas the shank 54 is manufactured from a tool steel. In the zone of the joint 55, the two parts 53, 54 are joined by fusing material together, for example by hard soldering. The tip 24 may, however, be manufactured entirely from a cutting material. As the cutting body 53, any desired standard tips may be used.

The shank 54 is formed with a slot 56 which extends in the longitudinal direction of the tip and which is open at the rearward end of the tip. The slot width 57 corresponds approximately to the head diameter 58 of the securing screw 30. The chip-breaker 25 or 25^1 may be manufactured in one piece or may consist of a forward hard metal part 59 and a rearward shank part 60 (Figure 8), these two parts being joined together by the fusing of material in the zone of the joint 61. The chip-breaker 25 or 25^1 is formed, in the zone of its rearward end, with a rearwardly open slot 62 or 62^1 the width 63 or 63^1 of which again corresponds substantially to the head diameter 58 of the securing screw 30. In respect of its height, the chip-former tapers in the direction towards its rearward end. The angle 66 between the chip-former surface 64 or 64^1 and the mounting face 65 or 65^1 is between 3 and 5°. The forward end face 67 of the chip-breaker 25 or 25^1 is bevelled, so as to achieve an advantageous chip escape.

The securing screw 35 as shown in Figure 7 is provided with a washer 44 which is so arranged on it as to be rotatable thereon but non-displaceable axially of the screw. The securing of the washer on the screw shank is effected by rolling-on, thus forming a bead 69 on the screw shank. In this way, the washer 44 is locked between the bead 69 and the screw head 70.

In the assembled condition of the tool holder the securing screw 35 engages through the slot 62 or 62^1 of the chip-breaker 25 or 25^1, the slot 56 of the tip 24 and the passage bore 34 in the washer plate 23, extending into the receiving bore 36 in the cutting tool holder shank 21. There, it is anchored in the internal screw thread 71 of a replaceable conical sleeve 72 the conical periphery of which bears against the conically extending walls of the lower portion of the receiving bore 36. The conicity of the conical sleeve 72 is so selected that, when the securing screw 35 is tightened, it is drawn, from below, into the receiving bore 36.

Instead of a conical sleeve 72, provided with an internal screw thread 71 and serving for receiving the securing screw 35, it is possible to provide an internal screw thread directly formed in the receiving bore 36. The axis of the securing screw 35 extends, in its assembled condition and in the case of all embodiments, perpendicular to the surface 64 or 64^1 of the chip-former 25 or 25^1.

As can be seen from Figures 3 to 8, in the assembled condition of the tool holder, the head of the securing screw 30 projects into the slot 56 in the tip 24 or the slot 62, 62^1 of the chip-breaker 25, 25^1 and secures it against rotation about the axis of the main securing screw 35. On tightening, the head 70 of the securing screw 35 presses the tip, over the washer 44 and the chip-breaker 25, firmly on to the shank 54 of the tip 24 (Figure 4). At the same time, the shank 54 is pressed firmly on the grooved face 39 or on the spikes 45 and 46, so that the point 40 of the grooved face 39 projecting above the plane of the bearing face 38 or the points 47, 48 of the spikes 45, 46 are pressed into the shank part 54 of the tip and in this way produce a positive connection between the washer plate 23 and the tip 24. This positive connection secures the tip in particular against displacement due to the back-pressure acting upon it in operation.

WHAT I CLAIM IS:—

1. A cutting tool including a holder and a cutting tip which is adjustable in a recess in the tool holder shank and which has a cutting body portion and a tip shank portion rearwardly thereof, the cutting body being made from a hard cutting material and secured fast with or formed integrally with the tip shank, and the tip shank being provided with a slot therethrough extending, and a headed securing screw anchored in the recess in the tool holder shank extending through the tip shank slot to secure the tip in the recess, adjustability of the positions of the cutting tip in the recess being permitted in the direction of extent of the slot.

2. A cutting tool holder according to claim 1, wherein the shank of the securing screw engages, as a clearance fit, through the tip shank slot.

3. A cutting tool holder according to claim 1 or 2, wherein the length of the tip shank slot is at least as great as the depth of the cutting body in the direction of extent of the slot.

4. A cutting tool holder according to claim 1, 2 or 3 wherein the shank of the securing screw is cylindrical.

5. A cutting tool holder according to claim 1, 2 or 3 wherein the shank of the securing screw is conically tapered in the direction towards the free screw end.

6. A cutting tool holder according to claim 5, wherein the maximum diameter of the conical screw shank is larger than the maximum width of the tip shank slot.

7. A cutting tool holder according to any preceding claim wherein the head of the securing screw is provided with a machined-on washer.

8. A cutting tool holder according to any preceding claim wherein the head of the securing screw or the washer associated therewith is formed with an annular recess in the surface facing the shank.

9. A cutting tool holder according to claim 8, wherein the annular recess is adjacent the screw shank.

10. A cutting tool holder according to any preceding claim wherein the tip shank slot has a closed periphery.

11. A cutting tool holder according to any one of claims 1 to 9, wherein the tip shank slot opens to the rear end of the tip shank.

12. A cutting tool holder according to any preceding claim, wherein the lateral walls of the tip shank slot are parallel with each other.

13. A cutting tool holder according to any one of claims 1 to 11, wherein the lateral walls of the tip shank slot converge in wedge-shaped manner in the direction towards the base face of the shank.

14. A cutting tool holder according to claim 13 when appendant to claim 5, wherein the wedge angle enclosed by the lateral walls of the tip shank slot corresponds to the cone angle of the screw shank.

15. A cutting tool holder according to claim 14, wherein the tip shank slot extends parallel to the lateral shank walls of the cutting body.

16. A cutting tool holder according to any preceding claim, wherein the recess in the clamping holder shank is delimited by lateral walls on each side of the cutting body shank.

17. A cutting tool holder according to claim 16, wherein the lateral walls of the recess extend paralel to each other.

18. A cutting tool holder according to any one of claims 1 to 15, wherein the recess is delimited by lateral walls only on that end of the tip which is adapted to be remote from the workpiece to be machined.

19. A cutting tool holder according to any preceding claim, wherein the bearing face of the cutting tool holder engageable by the tip exhibits a high degree of surface roughness at least over a portion of its length.

20. A cutting tool holder according to claim 19, wherein the bearing face is formed with notches at least over a portion of its length.

21. A cutting tool holder according to claim 20, wherein the notched face is covered with a file cut or rasp cut fluting.

22. A cutting tool holder according to claim 21, wherein the flanks of the notches taking up the back-pressure are more steeply inclined to the bearing face than the flanks remote from the back-pressure.

23. A cutting tool holder according to claim 19, wherein there project out of at least a portion of the bearing face, points of spikes which are manufactured from a material which is harder than that of the tip shank and which are let into the bearing face.

24. A cutting tool holder according to claim 23, wherein the spikes are made from hard metal.

25. A cutting tool holder according to claim 23 or 24, wherein the spikes and their receiving bores in the holder are so designed that they taper conically from below towards the bearing face.

26. A cutting tool holder according to any one of claims 19 to 25, wherein the unevennesses on the bearing face remote from the tip cutting edge are located behind the axis of the receiving bore for the securing screw.

27. A cutting tool holder according to claim 26, wherein the unevennesses do not extend rearwardly beyond the area of the head of the securing screw in the direction towards the end of the recess remote from the tool cutting edge.

28. A cutting tool holder according to any one of claims 19 to 27, wherein the bearing face is formed by the surface of a washer plate replaceably secured on the cutting tool holder shank.

29. A cutting tool holder according to claim 28, wherein the washer plate is secured, in lateral abutment against a recess receiving the tip on the tool holder shank.

30. A cutting tool holder according to claim 28 or 29, wherein the washer plate is secured on the cutting tool holder by two securing screws, one of which projects, with its head, into the slot in the tip shank in such a manner as to bear flush against the slot lateral edges.

31. A cutting tool holder according to any preceding claim, wherein a chip-breaker plate is interposed between the head of the securing screw and the tip, the rearward shank of the chip-breaker plate having a peripheral shape corresponding with that of the shank-side portion of the tip and being formed with a slot corresponding in shape with that of the tip shank slot.

32. A cutting tool holder according to claim 31, wherein the chip-breaker tapers in slightly wedge-shaped manner with respect to its height in the direction towards its rearward end, the axis of the securing

screw extending perpendicular to the surface of the chip-breaker remote from the tip.

33. A cutting tool holder according to any preceding claim, wherein a washer is provided between the head of the securing screw and the tip or the chip-breaker, the washer being rotatable relative to the screw but non-releasably connected thereto.

34. A cutting tool holder according to any preceding claim, wherein a tapped bore for receiving the securing screw is provided in a conical sleeve received in a conical bore in the cutting tool holder shank, said conical bore widening out in the direction towards the face of the tool holder shank remote from the tip.

35. A cutting tool holder constructed and arranged substantially as herein described with reference to and as illustrated in Figures 1 and 2 or 2*a* of the accompanying drawings.

36. A cutting tool holder constructed and arranged substantially as herein described with reference to and as illustrated in Figures 3 to 5 of the accompanying drawings.

37. A cutting tool holder according to claim 36 when modified as shown in Figure 6 and/or Figure 8 of the accompanying drawings.

38. A cutting tool holder according to claim 35, 36 or 37 when modified as shown in Figure 7 of the accompanying drawings.

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1171868 COMPLETE SPECIFICATION
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Sheet 1

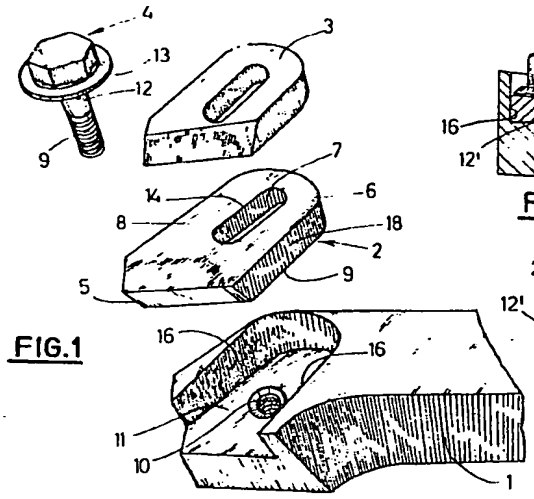


FIG.1

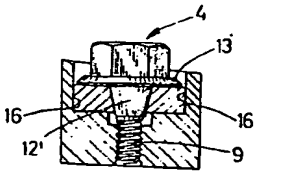


FIG. 2

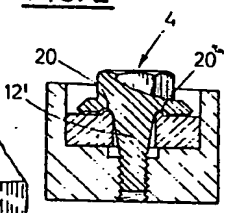


FIG. 2a

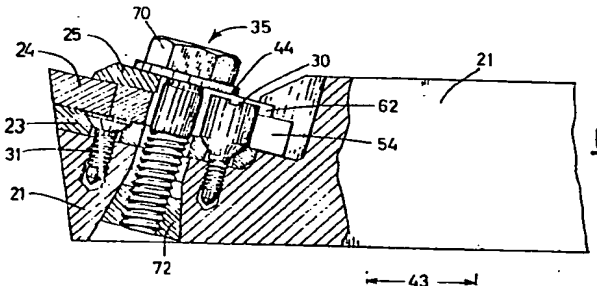


FIG. 4

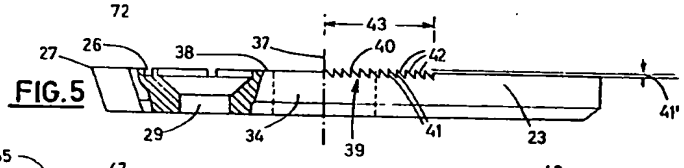
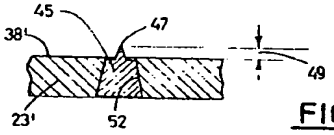


FIG.5



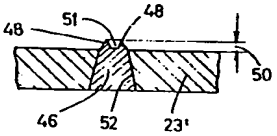


FIG. 6

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

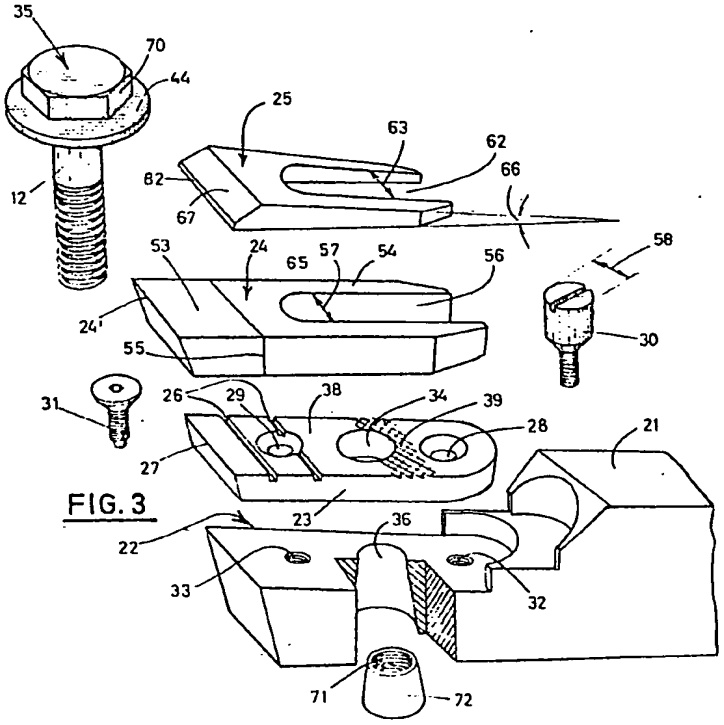

FIG. 3

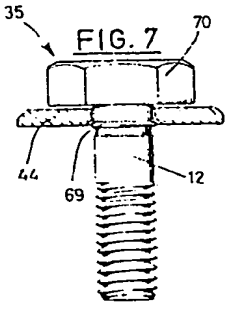

FIG. 7

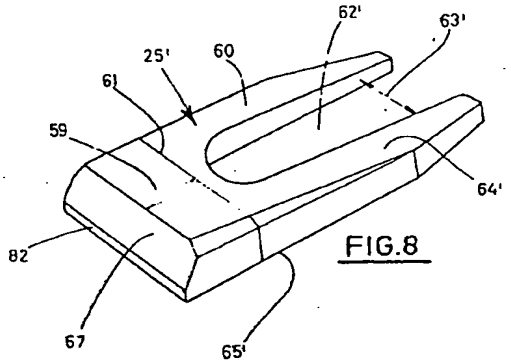

FIG.8